

8. Confusion About Renewable Energy

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We get free energy from the sun

- ▶ Physicists describe the situation as a “thermodynamically open” system
 - ▶ Humans, animals, even civilizations can grow for a time in a thermodynamically open system
 - ▶ Eventually we die – we are dissipative systems
- ▶ Because of free energy from the sun, if we live near the equator, we don't need to use much fuel for heating our homes
 - ▶ Homes don't need to be very sturdy, either
 - ▶ Low home cost and heating cost is a huge benefit
 - ▶ Reflected in lower needed wages for workers
 - ▶ Provides a competitive advantage to warm countries

Can we get further benefit from the sun's energy and other renewable energy sources?

▶ Examples

- ▶ Ethanol - produces substitute for gasoline
- ▶ Palm oil, rape seed oil – produces substitute for diesel
- ▶ Wind turbines – produces intermittent electricity
- ▶ Solar Photovoltaic (PV)– produces intermittent electricity
- ▶ Solar Thermal – mostly for heating hot water
- ▶ Geothermal – makes use of heat within earth, produces electricity
- ▶ Wave energy – produces intermittent electricity
- ▶ Gas obtained by decomposing garbage

Politicians would like us to believe that “renewable” energy provides huge benefits

- ▶ “Fuel” for new renewables is free
 - ▶ But this doesn’t mean that the end product we use is free
 - ▶ Or even inexpensive
 - ▶ Or available in large quantity
- ▶ Making “renewables” depends on existence of current system
 - ▶ Need coal, oil, and natural gas to make and transport devices
 - ▶ Need minerals of many kinds, including rare minerals
 - ▶ Need banking system, international trade
- ▶ What is the basic problem we are trying to address?
 - ▶ (1) Is problem *Cost of producing fossil fuels is rising too high*, or is it
 - ▶ (2) *Future supply shortage*

Historic understanding of need for renewables

- ▶ Mostly based on “supply” concern
 - ▶ Oil (or fossil fuel supply in general) will decline in supply
 - ▶ Biofuels would supplement
 - ▶ Or electric cars would replace current vehicles
 - ▶ Assumption is that we have a very long time for change
 - ▶ High cost is not a concern
- ▶ Another issue is climate change
 - ▶ Perhaps renewables would reduce CO₂ emissions
 - ▶ Renewables might replace part of coal use
 - ▶ Might also help with other pollution issues
- ▶ Additional political issue
 - ▶ Need for an “answer” to our problems
 - ▶ But without a very good understanding of nature of problem

Sources of Confusion

1. Is our problem a *supply problem* or a *cost problem*?

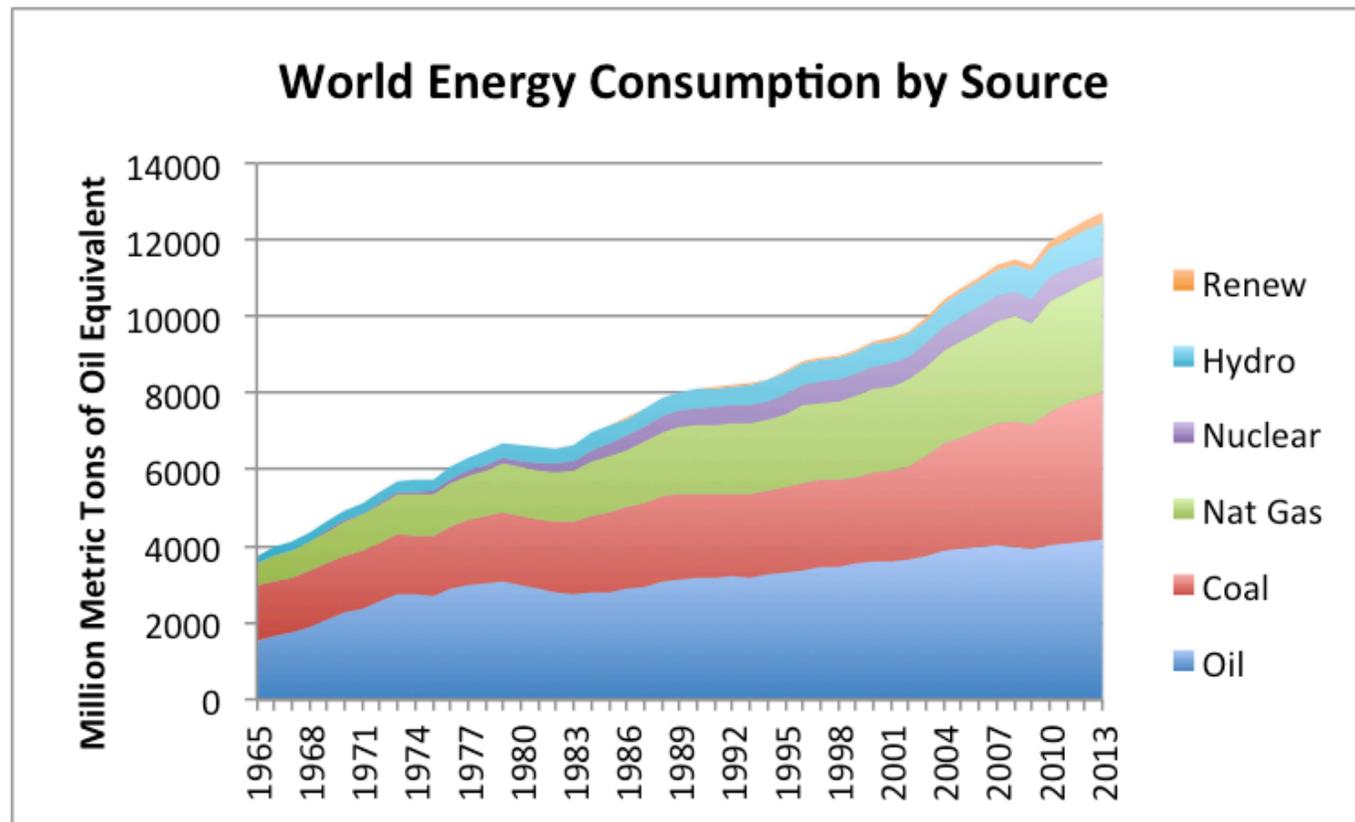
- ▶ If our problem is a cost problem, new renewables are only helpful if they *lower total costs*
 - ▶ New renewables tend to be expensive—need subsidies
 - ▶ Not helpful to governments with financial problems
 - ▶ Or to poor citizens, who are already having difficulty with low wages
- ▶ Most researchers have assumed our problem is a *supply problem*
 - ▶ Expect supply of oil to decline, because of peak oil
 - ▶ Also expect prices of oil and other fossil fuels to rise
 - ▶ Expect that high cost renewables will become competitive
 - ▶ If this story is wrong—collapse comes in the near term from low oil prices—then new renewables are not helpful

2. New renewables are only “add-ons” to our existing system

- ▶ We need oil, gas, and coal to make new renewables
 - ▶ Also to maintain the electric grid, roads, and pipelines
- ▶ If we lose the use of the electric grid, wind and solar PV that supply the electric grid will be of little value
 - ▶ Electric grid is difficult to maintain
 - ▶ Renewable device is of value only as long as rest of system “works”
 - ▶ Easy to assume too long a lifetime for renewables
- ▶ One potential benefit—even if electric grid system fails, a few homeowners with their own solar PV panels might benefit
 - ▶ Usually homeowners buying solar PV are rich homeowners
 - ▶ Does it make sense to tax the poor, so government can subsidize solar PV panels purchased by rich homeowners?

3. Quantity of “new renewables” is small compared to fossil fuels

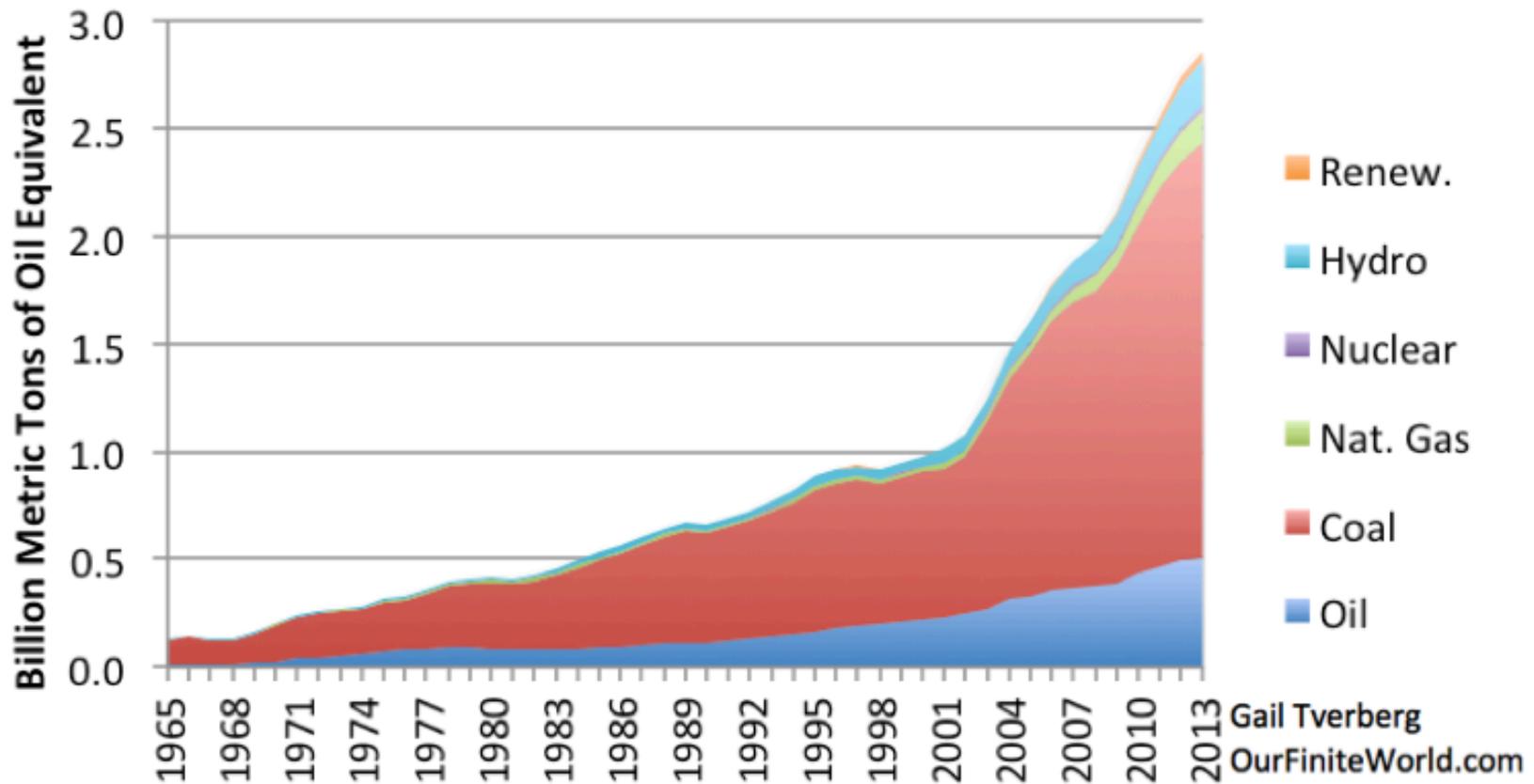
- ▶ On a worldwide basis, other renewables barely visible
- ▶ Other renewables > new renewables; includes wood



Based on Statistical Review of World Energy 2014 data

Quantity of new renewables is also very small for China

China Energy Consumption by Source



Based on BP Statistical Review of World Energy, 2014 data

Reasons “new renewable” quantities are low

- ▶ **Cost of producing new renewables tends to be high**
 - ▶ May be high human labor cost—example, installing solar PV
 - ▶ Also, uses many kinds of materials
 - ▶ Some of these are expensive—rare earth minerals used in wind turbines, for example
 - ▶ Fossil fuels are also used in making renewables
 - ▶ Debt financing needed for long periods
 - ▶ Interest expense is one of the costs as well
 - ▶ Citizens can't afford high cost; hard to subsidize sufficiently
- ▶ **Fuel cost is often a low portion of total electricity costs**
 - ▶ Coal, nuclear – fuel often 25% or less of total electricity cost
 - ▶ Eliminating fuel cost doesn't necessarily lead to savings

4. New renewables tend to be hard to “scale up”

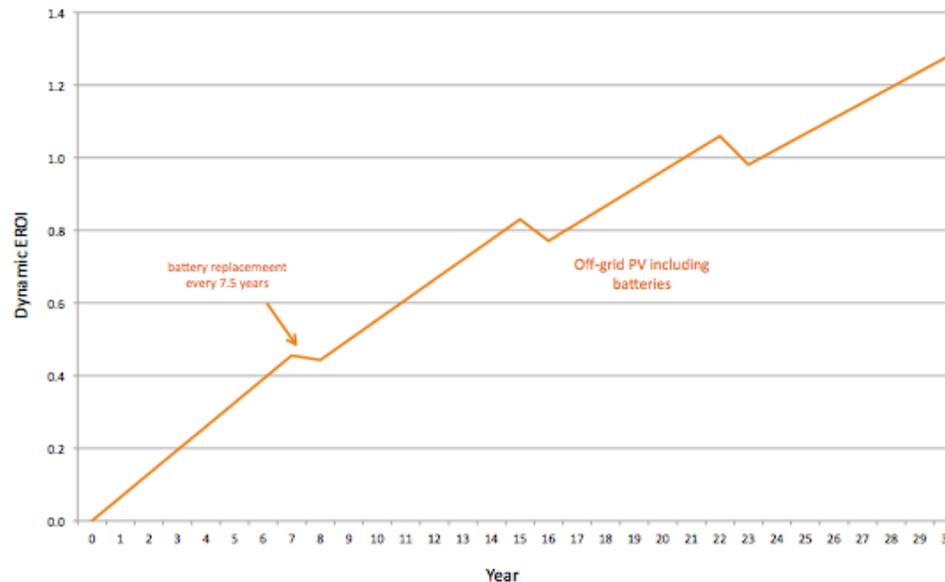
- ▶ Even if fuel is free, many materials used in creating renewables are in limited supply
 - ▶ Land is needed for growing biofuels—competes with food supply
 - ▶ Over 40% of US corn is used to provide 5% of US oil consumption
 - ▶ Rare earth minerals are used in wind turbines, electric cars
- ▶ Minerals of all types start with an initial limited supply of high quality ores
 - ▶ These can be rapidly depleted
 - ▶ Need to move to lower quality ores
 - ▶ Very similar to fossil fuels with respect to diminishing returns problem
 - ▶ “New renewables” represent an attempt to temporarily substitute materials that are less far along with respect to diminishing returns than fossil fuels
 - ▶ Not a permanent solution

5. It is difficult to calculate the true benefit of intermittent renewables

- ▶ Intermittent renewables: Wind, solar PV, wave energy
- ▶ Advocates want to equate *value of electricity produced by intermittent renewables to retail value of electricity replaced*
 - ▶ For example, if homeowners are paying \$0.15 per kWh, want to value electricity produced by solar PV panels at this price
 - ▶ Or give high feed-in tariff
- ▶ Savings to electric company may only be the cost of the fuel that would have been burned (\$0.03 or \$0.04 per kWh)
 - ▶ Usually, need just as much fossil fuel generating capacity as in the past
 - ▶ Also need as much or more grid capability
- ▶ Really need to do a detailed cost-benefit analysis
 - ▶ If a lot of nearby hydro-electric capability, benefit may be greater

Example of EROEI Problem

- ▶ Solar PV EROEI supposedly 9.4 to 1
- ▶ With batteries reaches 1.3, **after 30 years.**



- ▶ Dynamic EROEI with batteries, off-grid, based on figure by Graham Palmer in “*Energy in Australia*,” Springer, 2013.

6. Renewables have pollution problems of their own

- ▶ Minerals used in making devices may present pollution problems
 - ▶ Example: Extracting rare earth metals
- ▶ Wind turbines present noise problems; kill bats and birds
- ▶ Making these devices “moves forward” use of coal and natural gas
 - ▶ We extract these fuels earlier, in the hope that eventually energy usage will be reduced
 - ▶ Raises amount of debt outstanding, and indirectly cost of coal and natural gas
 - ▶ Savings only take place if reduction in other uses takes place

7. If we are trying to save CO₂, there are less expensive ways of doing it

- ▶ There seem to be many cheaper ways of reducing CO₂ compared to using renewables. Examples:
 - ▶ Switching coal use to natural gas
 - ▶ Paying people to insulate their homes better
 - ▶ Perhaps even using nuclear energy
 - ▶ But other pollution issues may outweigh benefits of nuclear

8. A major function of oil and gas has been to support governments financially

- ▶ For oil companies, as much as 90% of what would otherwise be profit must be paid in taxes
 - ▶ This is why governments of many countries own oil companies
 - ▶ If the price of oil drops, a major source of revenue to countries disappears
- ▶ Most renewables require large subsidies
 - ▶ Large subsidies are the opposite of paying high taxes
- ▶ Subsidies for renewables contribute to tendency toward financial collapse –it is governments that collapse
 - ▶ This is precisely the opposite effect of what people want

9. Renewables don't do what we need them to do

- ▶ What we need is replacements for virtually all of our types of energy
 - ▶ Need to match existing fuels exactly—gasoline, diesel, etc.
 - ▶ Need to be available in huge supply
 - ▶ Need to be available cheaply
 - ▶ Need to be non-polluting
 - ▶ Need to be available now

- ▶ Renewables don't even come close
 - ▶ Mostly renewables give politicians something to talk about
 - ▶ Make it look like they are really doing something favorable
 - ▶ And give researchers something to work on

10. Some renewables can be cost effective

- ▶ Solar thermal can be cost effective for heating water
 - ▶ Especially in warm areas
 - ▶ Seems to be long-lived as well
- ▶ Renewables that don't require banking and the electric grid have been available for many years, and may be available in the future as well
 - ▶ Wood
 - ▶ Bamboo
 - ▶ Animal labor
 - ▶ Water power (with simple devices that don't require fossil fuels)
 - ▶ Wind power to push boats, operate simple devices

Conclusion

- ▶ We would like to have *sustainable development*
- ▶ *Renewables* sound like they would be the way to sustainable development

- ▶ Unfortunately, in a finite world, development of any kind is not sustainable
 - ▶ Sustainable development is an *oxymoron* – it can't happen
 - ▶ Development must come to an end sometime
 - ▶ Just as the lives of plants and animals must come to an end
 - ▶ Also civilizations and economic growth must come to an end

- ▶ Our civilization doesn't end in a single day
 - ▶ But it may end in the lifetime of many of us